

Description

ONE-WAY VALVE WITH POPPET MEMBER

5 Technical Field

This invention relates generally to fluid valves, and more particularly concerns a one-way valve using a poppet member to control the flow of fluid therethrough.

10 Background of the Invention

In a one-way fluid valve, fluid is permitted to flow freely, with little resistance, in one direction, referred to as forward flow. Fluid is also generally prevented from flowing in the opposite direction through the valve, referred to as
15 backflow, i.e. the valve presents a high resistance to fluid backflow.

Examples of such one-way valves include reed valves and conventional poppet check valves. Reed valves use thin flaps of metal, referred to as reeds, to cover a supply port to
20 limit fluid backflow when the pressure at the supply port is less than the delivery pressure. When the pressure at the supply port is greater than the delivery pressure, the reeds bend to permit forward fluid flow through the valve.

Conventional poppet check valves include a moving
25 poppet member which covers the supply port to limit fluid backflow when the pressure at the supply port is less than the delivery pressure. When the pressure at the supply port is greater than delivery pressure, the poppet member moves to uncover the supply port to permit forward flow of the fluid
30 through the valve.

Reed valves and poppet check valves have known disadvantages. The thin metal reeds in the reed valves fatigue and break, due to high cycle bending in use. The poppets in the poppet check valves are typically heavy and hence have large
35 inertia, so that they are not useful in applications that require high frequency cyclical operation. Further, conventional poppet check valves have complex flow paths, requiring special purpose housings. Off-the-shelf commercial

components and material cannot be used to make poppet check valves.

Accordingly, it is desirable to have a reliable and long-lived one-way valve that is inexpensive and capable of
5 high-frequency cyclical operation.

Summary of the Invention

Accordingly, the present invention includes a one-way fluid valve, comprising: a valve housing which includes a fluid
10 supply section, including an entry port, and a delivery section, the housing further including a fluid chamber which receives fluid entering through the supply section and which is in fluid communication with the delivery section for delivery of fluid out of the valve; a poppet member positioned within the fluid
15 chamber and free to move within the fluid chamber during operation of the valve, the poppet including a seating surface portion and a rim portion which includes passages therethrough which permit flow of fluid through the poppet member; a delivery poppet seat defined within the fluid chamber, which the rim
20 portion of the poppet contacts during forward flow of fluid through the valve; and a supply poppet seat defined within the fluid chamber which the seating surface portion of the poppet contacts to minimize backflow of fluid through the valve during backflow of fluid into the fluid chamber.

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Description of the Drawings

Figures 1A and 1B are cross-sectional views of one embodiment of the one-way valve of the present invention, showing fluid flow in the forward direction (1A) and resistance
30 to back flow (1B).

Figures 2A and 2B are cross-sectional views of an alternative embodiment to the one-way valve of Figures 1A and 1B.

Figures 3A, 3B and 3C are top, side elevation and
35 cross-sectional views of the poppet portion of the one-way valve of Figures 1A and 1B and 2A and 2B.

Best Mode for Carrying Out the Invention

Figures 1A and 1B show a first embodiment of the one-way valve of the present invention. The valve 10 includes a compression fitting 12 with a supply tube 14 at a supply end 16 of the compression fitting and a threaded portion 18 formed in a delivery end 20 of the fitting. The compression fitting 12, with its threaded portion 18, and supply tube 14, are conventional, off-the-shelf elements.

Valve 10 is referred to generally as an inlet valve, since the supply tube 14 receives fluid through an inlet port/opening 22, while the threaded portion 18 includes a delivery port/opening 24.

In operation, fluid is moved in the forward direction between inlet port 22 and delivery port 24. Valve 10 further includes a poppet member 28 located in a fluid chamber 30 located between an interior end 31 of supply tube 14 and an inboard end surface 32 at longitudinal opening 33 in threaded portion 18. Poppet member 28 has a small mass and therefore a small inertia.

Referring now to Figures 3A-3C in the embodiment shown, poppet 28 has a base or rim portion 34 and a conical portion 35 which extends away from the rim portion 34. The base of conical portion 35 has an outside diameter which is substantially identical to the outside diameter of rim portion 34. Rim portion 34 has a plurality of openings 36 which permit fluid flow into interior 37 of the poppet 18 through openings 36 and then out of the poppet. The poppet 28 is configured relative to the diameter of the inboard end 31 of the supply tube and the inboard end surface 32 at opening 33 such that when the one-way valve is in its open position, a base surface 38 of the poppet seats against inboard end surface 32.

In operation, fluid will be delivered through supply tube 14 into fluid chamber 30, and then through poppet 28 to delivery port 24. This is forward fluid flow.

When valve 10 is closed, conical portion 35 of the poppet mates or seats against an inner peripheral edge 42 of the inboard end 31 of supply tube 14. This arrangement limits

backflow, since there is no clear path for the fluid to move through or past poppet 28 into the tube 14.

5 In one embodiment, inner peripheral edge 42 of inboard end 31 of the supply tube is made from a significantly softer material from that of poppet member 28, so that edge 42 deforms to accommodate irregularities in the poppet rim base surface, so as to minimize leakage between poppet 28 and the inner peripheral edge 42 of inboard end surface 32.

10 As indicated above, inner peripheral edge 42 can be made of material which is significantly softer than the material from which the poppet 28 is made, so that the edge 42 deforms to accommodate irregularities in the poppet surface, to minimize backflow. These irregularities can result from imperfections during the manufacturing process, scratches or other blemishes
15 caused by contaminants in the fluid flow, or the result of normal wear. The inner peripheral edge 42 can be sharp, sometimes referred to as a knife edge, which when mating with a poppet surface (the conical portion 35) provides only very limited opportunities for leakage between the cone portion of
20 the poppet and the knife edge supply tube seating surface.

The poppet can be lightweight, with a relatively small inertia, so that it can move rapidly to accommodate high-speed opening and closing cycles. For instance, in a valve like that shown in Figures 1A and 1B, where the openings through the
25 supply tube 14 and through the threaded portion 18 are approximately 0.312 (5/16) inches in diameter, respectively, with the poppet being approximately 0.375 (3/8) inches in diameter at its base, with a height of 0.200 inches, the poppet could weigh within the range of 0.1-1 grams.

30 Poppet 28 may be made from material such as stainless steel, which can be significantly harder than the material comprising either the inboard end of the threaded portion 18 or the inboard end of the supply tube 14. The advantage of the poppet being made from hard material is that it is resistant to
35 wear.

Since the valve is formed by a readily available compression fitting and a single piece of tube, the embodiment shown is inexpensive to manufacture, since only simple

manufacturing steps are required to assemble the valve, from off-the-shelf commercial components. The poppet is the only component which must be custom manufactured.

5 The poppet 28 shown in Figures 1A and 1B, in an inlet valve arrangement, in which the fluid moves into the valve at supply tube 14 and out through threaded portion 18, can be reversed, so that the fluid supply is located at the threaded portion of the valve and the delivery of the fluid is at the outboard end of the tube. Figures 2A and 2B show such an arrangement, referred to as an outlet valve. These figures show a similar compression fitting 30 to that shown at 12 in Figures 1A and 1B. The complete valve is referred to in general at 50 in Figures 2A and 2B. It includes a tube 52 at one end 54 of the compression fitting, with a threaded portion 56 formed in 15 the other end 58 of the fitting.

In the arrangement of Figures 2A and 2B, fluid enters the valve at end 58 through threaded portion 56 and exits the valve at end 54 through the tubular portion 52.

As discussed above, poppet 28 is reversed in fluid 20 chamber 62 in Figures 2A and 2B relative to its position in the embodiment of Figures 1A and 1B. Figure 2A shows the position of the poppet during forward flow operation of the valve, in which fluid moves through the valve 50, while Figure 2B shows the position of the poppet when it is limiting backflow back 25 through the valve. When the one-way valve 50 is in its open position, rim base surface 38 of poppet 28 seats against seating surface 66 at the inboard end of tubular portion 52. In this position, fluid in the threaded portion 56 flows into fluid chamber 62, enters poppet 28 through radial openings 36 at the 30 rim base portion of the poppet into the interior 37 thereof and then through tube 52, and out delivery opening 72 in tubular portion 52 of the valve.

When the one-way valve 50 is closed, with poppet 28 in the position shown in Figure 2B, backflow is limited since 35 there is no clear path for the fluid to move through or past the poppet into tube 52. Further, conical surface 35 of poppet 28 contacts circumferentially the seating surface edge (knife edge) 75 of the threaded portion 56. Hence, there is typically a

good, continuous contact between the poppet conical surface 35 and the circumferential seating edge of the threaded portion of the valve, substantially preventing fluid from escaping between the conical portion 35 and the seating surface edge.

5 Accordingly, a new one-way valve has been disclosed, which involves a compression fitting and a tube which are readily commercially available and a poppet which operates between two extreme positions to permit fluid flow in the forward direction, but substantially prevent (limit) fluid flow
10 in the reverse direction.

 Although a preferred embodiment of the invention has been disclosed here for purposes of illustration, it should be understood that various changes, modifications and substitutions may be incorporated without departing from the
15 spirit of the invention, which is defined by the claims which follow.

What is claimed is: